BEACON MONITOR OPERATIONS

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TMO Technology Program Quarterly Review

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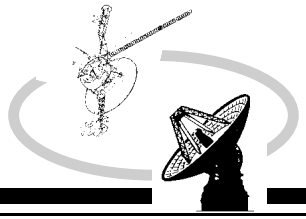
Beacon Monitor Operations
Beacon Monitor Flight Software Task

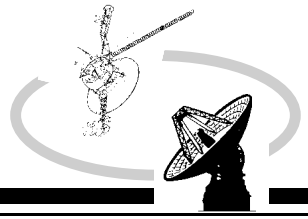


Overall Objective

Reduce the cost of long duration cruise missions and decrease the loading on DSN antennas by creating a new approach to operations that reduces frequency of contact and volume of downlinked engineering telemetry.

Goals	Significance
#1: Develop a low cost end-to-end tone monitoring system and flight demonstrate it on the Deep Space One mission	• **The tone monitoring system enables the NASA vision of "darkening the skies" with small spacecraft. Implementing beacon operations can also save upwards of $3M/yr on planned missions to Europa and Pluto**
#2: Develop end-to-end software for onboard data summarization and demonstrate it on the Deep Space One mission	• **Onboard summarization is necessary when the frequency of tracking is reduced and to reduce the time required to handle and analyze engineering telemetry**
#3: Coordinate development of a baseline operational concept for future missions and perform key flight-ground trades to determine cost benefit of implementing a tone service within the DSN given the ops constraints of small spacecraft.	• **Investigations into creative operational approaches (shared and on-demand operations) is necessary and will be demonstrated through dedicated time during DS1 operations**

Beacon Monitor Operations
Products and Customers



Product	User/Customer	Development Phase: Concept	Design	Demo	Transfer	Approach/Comments
Tone Selection Flight SW	↑	■	■	■	■	All three items transferred to DS1 Beacon Monitor Operations Experiment. Concept, design, and some prototypes transferred to X2000 testbedding program.
Onboard Summarization Flt SW	Deep Space One X2000 Program	■	■	■	■	
Ground System Software	Ice & Fire Program (Pluto, Europa Missions)	■	■	■	■	
Flight Validation Experiments	MIDEX clock proposal Applied Physics Lab	■	■	■	■	
Tone Detection Algorithm	U. Colorado Stanford SSDL ↓	■	■	■	■	

Beacon Monitor Operations
The "Big" Picture

By filling boxes (using codes below), show graphically how your work area/unit fits into this high level view of the overall TMOD environment, name the elements of the end to end system you are working on and what layers in these functions you contribute to.

Fill Codes:
- Flight
- Ground
- Flight & Ground

Check all that apply:
- ☐ Automation
- ☐ Autonomy
- ☐ GSE
- ☐ Development
- ☐ Operations
- ☐ Flight
- ☐ Ground
- ☐ H/W
- ☐ S/W
- ☐ Protocol
- ☐ Testbed

Avionics

Instrument

Telecom & Relay

Schedule

Nav & Trk

Plan & Seq

Miss Des

Analyze

Rcvr

Cmnd

Ant / Optics

Networks

Eng Proc

Visualize

Xmtr

Telemetry

Data Mgmt

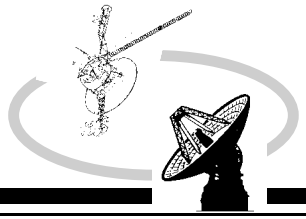
Sci Proc

Data Prod

Other Infra

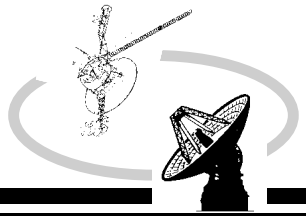
Mon & Cntrl

Beacon Monitor Operations
Relevant Technical Skills



RELEVANT SKILLS	DESCRIPTION
System Engineering	Tailor technology to mission (customer) needs, perform flight-ground and other trades, coordinate development of system components
Telecommunications	Perform telecom trades, design/develop tone system, develop a tone detection algorithm
Software Engineering	Develop flight software architecture(s), design ground system software
Artificial Intelligence	Develop advanced software for onboard health monitoring and engineering data summarization, integrate technology into flight software architecture
Mission Operations	Develop overall operational concept to meet mission requirements, develop ops procedures, estimate cost savings during operations, plan DS1 technology validation operations, conduct mission operations experiment on DS1

Beacon Monitor Operations
FY98 Q1 Accomplishments



✓ • **Tone Detector**

Planned initial checkout activities for tone system by participating in DS1 project activities, evaluated ability to use beacon system on Mars'01lander, analyzed compatibility test data, coordinated with DST dev. efforts, reconfigured signal detection software to work with upgraded Full Spectrum Recorder (FSR)

✓ • **Flight Software**

Completed development of several flight software modules to be used on DS1, made improvements to the software test plan, hired a software test engineer, secured an MOU to betterassure flight software will be integrated pre-launch, participated in DS1 mission planning activities

✓ • **Ground Software**

Made incremental improvements to the data visualization environment, began system engineering of tone notification system, began planning remaining builds

✓ • **End-to-end Demo**

Improved the tone system and the data summarization demos, gave each several times (incl. demos to X2000, DS1, and HQ)

✓ • **JPL Mission Customers**

DS1 - developed an ops concept for using beacon system as a mid-week strategy

X2000 & Ice & Fire - coordinated with development planning activities

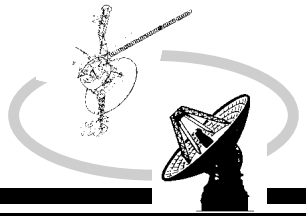
Champollion - received assurances that the technology is baselined

MIDEX Clock proposal - will be incorporated into operational concept

\+ • **Tech Transfer**

APL has expressed an interest in receiving the technology and providing additional an additional tone detection site during the DS1 experiment

Beacon Monitor Operations
FY98 Q2 Planned Accomplishments



- ✓ **Tone Detector**
  - **Continue analyzing compatibility test data, continue developing operational procedures**
- ●●● **Flight Software**
  - **Develop standalone test environment, conduct comprehensive FSW tests using representative spacecraft data, develop operational procedures (Complete FSW integration, orig. scheduled fo 1/19 has been delayed due to delays in DS1 fault protection schedule -- FSW will be made available for optimistic integration with DS1 fault protection on 3/31)**
- ✓ **Ground Software**
  - **Add software configuration tools to ground software suite to assist in developing in-flight parameter updates, release next version of GSW**
- ✓ **End-to-end Demo**
  - **Release next version of demo**
- ✓ **JPL Mission Customers**
  - **DS1 - X2000 & Ice & Fire - plan X2000 testbed deliveries**
  - **Champollion - engage in detailed discussions w/ Champollion project**
  - **MIDEX Clock proposal - provide information to assist in developing a detailed cost estimate**
- \+ **Tech Transfer**
  - **Make determination on APL participation in DS1 experiment, continue technical discussions, complete planning on data summarization workshop to be held later in FY98**

Beacon Monitor Operations
Schedule